Sub: Introduction to Civil Engineering (22ESC241)

Module-1 Notes

Civil Engineering Disciplines and Building Science

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Introduction to Civil Engineering: Fields of Civil Engineering

1. **Surveying:** Scope of surveying are
    - For preparing the contour map to determine the best possible route and amount of earthwork required
    - For preparing the engineering map showing engineering details like highways, railways, canals, dams, reservoirs, etc.
    - Maps prepared for marking boundaries of countries, states, districts etc., avoid disputes
    - For preparing the contour map to determine the best possible route and amount of earthwork required
    - For preparing the engineering map showing engineering details like highways, railways, canals, dams, reservoirs, etc.
    - Maps prepared for marking boundaries of countries, states, districts etc., avoid disputes

2. **Geotechnical Engineering:** Scope of Geotechnical Engineering are
    - To assess the quality and strength of soil to construct civil engineering structure
    - To design retaining walls for soil retainment.
    - To decide type of foundations for different type of structures.
    - For design of underground structures such as Tunnels, Shafts, Conduits.
    - Design of earthen dams for storage of water.
    - For design of Roads for transportation facilities.

3. **Structural Engineering:** Scope of structural Engineering are
   - Analysis and design of Dams, Bridges, Stadiums, Auditoriums, Multi - storied buildings.
   - Analysis and design of power generation stations
   - Analysis and design of steel industrial structures
   - Repair, rehabilitation and maintenance of structures
   - Design of nuclear Power plants.
   - Design of structural reinforcement for different type of structural components

4. **a)Hydraulics Engineering:** Scope of Hydraulic Engineering are
   - To measure the discharge of water in rivers for design of bridges
   - Design of hydro power plants for generation of electricity.
   - Design of Pumps and turbines
   - Design of water supply schemes for the city which includes design of pipes and pumps.
   - Design of canals to carry water to irrigation land from dams.
   - Design of Weirs for Dams.

b) Water Resource Engineering: Scope of water resource engineering are

- To arrive the total discharge of water from catchment areas
- To design the reservoir capacity to store the water
- For water quality management and pollution control.
- Supply of water for garden and recreational centers.
- Design of water supply systems for the cities and industries.
- To measure the total rainfall

5. **Transportation Engineering:** Scope of Transportation engineering are
   - It involves planning, design, construction, operation and maintenance of transportation facility.

- Planning and design of runways, roads, harbors and railways
- Maintenance and up gradation of harbors, airports, railway system based on requirements.
- It contributes economic, industrial, social and cultural development of any country.
- Design of traffic signals for control of traffic.

6. **Environmental Engineering:** Scope of Environmental Engineering are
    - Involves collection of water, Purification and supply for drinking.
    - Waste water collection, treatment and disposal
    - Air pollution control and treatments.
    - Solid waste management and control
    - E-Waste management control and Treatment
    - Construction waste management and control

7. **Construction planning and Project Management:** Scope of Construction planning and Project Management are
    - It involves the choice of technology, the estimation of the required resources and durations for individual tasks etc,.
    - A good construction plan is the basis for developing the budget and the schedule for work
    - In is the master plan that ensures a construction project runs smoothly and meets all its deadlines, budget constraints, and quality standards.
    - It involves the material storage, labours and equipment's required for the completion of the Project.
    - Critical Path Method (CPM) is used to execute the work in a planned manner such that the project is completed within specified time and allotted budget.

Basic Materials of Construction

Following are the basic materials of construction:

1. Brick:

Brick is a small rectangular block typically made of fired or sun-dried clay, used in construction**.**

Good qualities of Bricks:

- The bricks should be table-moulded, well burnt in kilns, copper-coloured, free from cracks and with sharp and square edges.
- The bricks should be uniform in shape and should be of standard size.
- The bricks should give a clear metallic ringing sound when struck with each other.
- The brick should not absorbs water more than 20% by weight, for first class bricks and 22% by weight for second class bricks, when soaked in water for a period of 24 hours.
- No impression should be left on brick surface, when it is scratched with finger nail.
- The bricks should not break into pieces when dropped flat on hard ground from a height of about one meter.
- The bricks should have low thermal conductivity and they should be sound proof.
- The bricks, when soaked in water for 24 hours, should not show deposits of white salt when allowed to dry in shade.

Types of Bricks

1. Sun-dried bricks

Unburnt bricks or sundried bricks are the most basic example for bricks. They are not so strong, have reduced fire and water resistance, and hence they are used in temporary structures

2. Burnt Clay Bricks

Burnt bricks are good quality bricks and burnt bricks are classified into four types and they are

- **First class bricks:** They are table-molded and burnt in large kilns. So, these bricks contain standard shape, sharp edges and smooth surfaces.
- **Second class bricks:** Second class bricks are moderate quality bricks and they are molded by ground-molding process. These bricks are also burnt in kilns. But because of ground molding, they do not have smooth surfaces as well as sharp edges
- **Third class bricks:** Third class bricks are poor quality bricks which are generally used for temporary structures like unburnt bricks.
- **Fourth class bricks:** Fourth class bricks are very poor quality bricks and these are not used as bricks in the structure. They are crushed and used as aggregates in the manufacturing of concrete.

3. Fly Ash Bricks

Fly ash bricks are manufactured using fly ash and water. These bricks have better properties than clay bricks and great resistant to freeze thaw cycles

4. Concrete Bricks

Concrete bricks are manufacturing using concrete with ingredients as cement, sand, coarse aggregates and water. These bricks can be manufactured in sizes as required.

5. Sand Lime or Calcium Silicate Bricks

Calcium silicate bricks are made of sand and lime and popularly known as sand lime bricks. These bricks are used for several purposes in construction industries such as ornamental works in buildings, masonry works etc.

Tests on Bricks:

1. Absorption Test on Bricks

Absorption test is conducted on brick to find out the amount of moisture content absorbed by brick under extreme conditions. For a good quality brick the amount of water absorption should not exceed 20% of weight of dry brick.

2. Crushing Strength or Compressive Strength Test on Bricks:

Crushing strength of bricks is determined by placing brick in compression testing machine. Minimum crushing strength of brick is 3.50N/mm2, if it is less than 3.50 N/mm2, then it is not useful for construction purpose.

3. Hardness Test on Bricks

A good brick should resist scratches against sharp things. So, for this test a sharp tool or finger nail is used to make scratch on brick. If there is no scratch impression on brick then it is said to be hard brick.

4. Shape and Size Test on Bricks

Shape and size of bricks are very important consideration. All bricks used for construction should be of same size

5. Color Test of Bricks

A good brick should possess bright and uniform color throughout its body

6. Soundness Test of Bricks

In this test, 2 bricks are chosen randomly and struck with one another. Then sound produced should be clear bell ringing sound and brick should not break. Then it is said to be good brick.

7. Efflorescence Test on Bricks

A good quality brick should not contain any soluble salts in it. If soluble salts are there, then it will cause efflorescence on brick surfaces.

Advantages of Brick Masonry:

- Bricks are having uniform shape and size.
- Handling is easy with brick as the bricks are light in weight.
- Brick is easily available and transportation cost is less
- Construction cost can be reduced in brick masonry as mortar joints are thin.

Disadvantages of Brick Masonry

- Not as strong as other materials such as stone.
- Not as durable compared to stone.
- Brick masonry needs plastering to protect from weathering.
- Brick absorbs water which will cause dampness and damage to the structure.
- Less aesthetic view with brick as there is limited sizes and colors.

2) Cement:

Cement is a powder of alumina, silica, lime, iron oxide, and magnesium oxide burned together in a kiln and finely powdered and used as binding material in mortar and concrete.

Uses of Cement

- The most significant use of cement is production of concrete and mortar
- It is used in concrete for laying floors, roofs and constructing lintels, beams, stairs, pillars etc.
- It can be used for preparation of foundations, watertight floors, footpaths, etc.
- It can be used for manufacturing precast pipes, garden seats, flower pots, dust bins, fencing posts, etc.
- It is used in the construction of water Tanks

Different types of cements

- **Ordinary Portland cement:** This cement is used in general concrete construction where there is no exposure to sulphates in the soil or in groundwater
- **Portland pozzolana cement:** PPC is used for the structures having direct contact with water such as marine structure, dams, bridge piers, sanitation system like Sewers and thick foundation where mass concrete is used.
- **Rapid hardening Portland cement:** It is generally used in road work and bridge construction where the time factor is very important.
- **Portland slag cement:** It can be used in mass concrete structures such as retaining walls, foundation, and dams.
- **Sulphate resisting Portland cement:** Since ordinary Portland cement is susceptible to attack of sulphate hence sulphate resisting Cement is developed to use where the soil is infected with sulphates
- **Quick setting Cement:** Quick setting cement sets very fast. This cement is used for foundation where pumping of water is needed

Requirements of good cement:

1) Fineness of Cement

The size of the particles of the cement is its fineness. The required fineness of good cement is achieved through grinding the clinker in the last step of cement production process. Fineness of cement should not be more than 10%

2) Soundness of Cement

Soundness refers to the ability of cement to not shrink upon hardening. Soundness should not be more than 10mm

3) Consistency of Cement

The ability of cement paste to flow is consistency. It is measured by Vicat Test. Generally the consistency of cement is 29%.

4) Strength of Cement

- **Compressive Strength:** It is the most common strength test on cement. The test specimen of 50mmx50mmx50mm are casted and after curing the specimens are tested under compressive loads until failure
- **Tensile strength:** Split tensile test is conducted for determining the tensile strength of cement.
- **Flexural strength:** This is actually a measure of tensile strength in bending. The test is performed on a 40 x40 x 160 mm cement mortar beam, which is loaded at its centre point until failure.

5) Setting Time of Cement

Cement sets and hardens when water is added.

- **Initial setting time:** When the paste begins to stiffen which is typically occurs within 30-45 minutes
- **Final setting time:** When the cement hardens, being able to sustain some load which occurs in between6 to 10 hours

6) Specific Gravity (Relative Density)

Specific gravity is generally used in mixture proportioning calculations. Portland cement has a

Specific gravity of 3.15

3 Mortars

Mortar is a bonding agent which is generally produced by mixing cementing or binding material

Types of Mortar

1) Cement Mortar

Cement mortar is a type of mortar where cement is used as binding material and sand is used as fine aggregate. Depending upon the desired strength, the cement to the sand proportion of cement mortar varies from 1:2 to 1:6. like Lime or Cement and fine aggregate sand or surkhi with water.

2) Lime Mortar

Lime mortar is a type of mortar where lime (fat lime or hydraulic lime) is used as binding material and sand is used as fine aggregate.

3. Surkhi mortar

Surkhi mortar is a type of mortar where lime is used as binding material and surki is used as fine aggregate.

4. Mud Mortar

Mud mortar is a type of mortar where mud is used as binding material and sawdust, or cow-dung is used as fine aggregate. Mud mortar is useful where lime or cement is not available.

Qualities of good mortar:

- The main quality that mortar should possess is adhesion. Good mortar should provide good adhesion to building units (bricks, Stones etc).
- Mortar should be water resistant. It should have the capability of resisting the penetration of water.
- Deformability of mortar should be low.
- Mortar should be easily workable in the site condition.
- It should possess high durability
- Cracks should not be developed in the joint formed by mortar.

Functions/uses of Mortar in Construction:

- Mortar is used to bind together the bricks or stones in brick or stone masonry.

- It is used to give a soft even bed between different layers of brick or stone masonry for equal distribution of pressure over the bed.
- It is used to fill up the spaces between bricks or stones for making walls tight
- It is used to fill up the spaces between bricks or stones for making walls tight
- It is used in pl astering works to hide the joints and to improve appearance

5. Plain Cement Concrete

Plain cement concrete is the mixture of cement, fine aggregate (sand) and coarse aggregate without steel.

Material Used in Plain Cement Concrete:

1. Coarse Aggregate

Coarse aggregate used in the PCC must be of hard broken stone of granite or similar stone, free from dust, dirt and other foreign matter. The stone ballast shall be 20 mm in size and smaller.

2. Fine Aggregate

Fine aggregate shall be of coarse sand consisting of hard, sharp and angular grains and free from dust, dirt and organic matter.

3. Cement

Portland Pozzolana cement (P.P.C) is normally used for plain cement concrete.

4 Water

Generally, potable water shall be used having a pH value not less than 6.

Uses of Plain cement concrete

- As bed concrete below the wall footings, column footings
- As sill concrete to get a hard and even surface at window and ventilator sills.
- As to coping concrete over the parapet and compound walls.

- It is used in rigid pavement construction for transportation
- Storm/ Sewer at drains, small retaining walls.
- To make tennis courts, basketball courts etc
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6. RCC (Reinforced Cement Concrete)

Reinforced Cement Concrete (RCC) is a composite building material consisting of concrete reinforced with steel.

Advantages of Reinforced Cement Concrete:

- Fresh concrete will be in the form of fluid and so it can be poured and casted into any shape. It gives easiness to the engineer to decide the shape of structure based on architectural aspects.
- RCC with proper cover will withstand to fire for about 3 – 4 hours. RCC will also resist any type of weathering.
- After the completion of work low maintenance is needed for concrete structures compared to the other (steel and timber) type of structures.
- Steel and Concrete are a commonly used construction material and so it is easily available to prepare reinforced cement concrete.
- Reinforced Concrete members are good in rigidity due to their stiffness.

Disadvantages of RCC:

- RCC sections are heavier comparatively to the sections made with other construction materials like Steel, wood, etc.
- It requires lots of formwork, centring and shuttering to be fixed
- RCC takes time to gain its full strength, because cement gains strength very slowly.
- RCC needs too much maintenance during its construction, like proper curing, checking of cracks, prevention from direct sunlight, etc.
- RCC sections consume more space than other sections made with construction materials like Steel.

Uses of RCC

- Reinforced concrete is used for the construction of roof slabs, columns, beams and footings in residential and commercial structures.
- Reinforced concrete is used for construction of bridges of small, medium and long spans resulting in aesthetically superior and economical structures in comparison with steel bridges
- Reinforced concrete is used in the construction of roads that is designed to carry heavy traffics loads.
- Pipes and conduits have been constructed from reinforced concrete
- Electric poles are made from reinforced cement concrete.
- For construction of bunkers the reinforced concrete is used.

7. PSC (Pre-stressed concrete)

Pre-stressed concrete is a structural material in which predetermined, engineering stresses are introduced in to resist the stresses that occur when the material is subject to loading.

Following are the uses of PSC:

1) Construction of Bridges:

Pre-stressed concrete has applications in the construction of bridges. This type of bridge is very strong and durable and is often used in the construction of long-span bridges.

2) Construction of Buildings:

Pre-stressed concrete is a construction material that is commonly used in the construction of buildings. Pre-stressed concrete is often used for beams and columns, as well as for floor and roof slabs in pre-stressed concrete buildings

3. Construction of Storage Tanks:

Pre-stressed concrete is commonly used in the construction of storage tanks. The advantage of using pre-stressed concrete tanks is that they can be designed to resist the internal pressure of the tank contents. This results in a lighter and thinner wall, which reduces the overall weight of the tank

4. Railway sleepers:

Pre-stressed concrete sleepers are used in rail tracks. The PSC sleepers are extremely strong and durable and is less likely to be damaged by weathering or other environmental factors.

5. Concrete Pavements:

Pre-stressed concrete is used in concrete pavements to improve their strength and durability.

8. Structural steel:

Steel is a kind of metal alloy that's made of iron and carbon. Due to its high strength it is often used to build the framework of high rise buildings.

Uses of structural steel:

1) To Build High Rise Buildings

Structural steel is resistant to external forces such as wind and earthquakes. Hence the high rise buildings are constructed using steel members.

2) To Build Industrial Sheds

Another benefit of structural steel is that it is cost effective and hence it is used in the construction of industrial sheds

3) To Build Bridges

Steel has a high strength to weight ratio, which means, steel is a tensile metal and is used in construction of bridges

4) To Build Parking Garages

Structural steel is useful to build parking garages. Due to light weight of structural members it easier to construct structures.

5) To Build Residential Buildings

They should be able to withstand external forces such as wind, earthquakes, and storms hence used in residential buildings

Classification of steel

1) Low-carbon steel – This class of steel contains up to 0.30% C. Low carbon steel is used for automobile body panels, tin plates and wire products.

2) Medium-carbon steel – This class is similar to low carbon, except it ranges from 0.30% – 0.60% C. Medium carbon steel is mainly used for shafts, axles, gears, crankshafts, couplings and forgings.

3) High-carbon steel– This of steel ranges from 0.60% – 1.00% C. High carbon steel is used for spring materials and high-strength wires.

4) High-strength low-alloy steel – This steel alloy is designed to provide better mechanical properties and greater resistance to atmospheric corrosion.

5) Low-alloy steels – This alloy's primary function is to increase its strength and toughness after heat treatment.

8. Construction Chemicals:

1. Concrete Admixtures

Admixture is a material which is one of the ingredients of concrete apart from cement, water and aggregates. It is added to the batch immediately before or during mixing. In some conditions, ordinary concrete fails to give the required quality performance or durability. In such situations, admixtures are used to modify the properties of ordinary concrete so as to match the requirement, thereby making it more suitable for the situation.

Some of the admixtures are given below:

i) Plasticizers (Water Reducers)

The organic substances or the combinations of organic and inorganic substances, which offer a higher workability at the same water content, are known as plasticizing admixtures.

ii) Super Plasticizers

Use of super plasticizers allows the reduction of water to the extent up to 30 % without reducing workability

iii) Retarders and Retarding Plasticizers

Retarders are admixtures that slow down the chemical process of hydration so that concrete remains in the plastic state and it remains workable for a longer time than concrete without the retarder.

iv). Accelerators and Accelerating Plasticizers

Accelerating admixtures are added in the concrete to increase the rate of early strength development in concrete so as to Permit earlier removal of formwork and reduces the required period of curing

v) Bonding Admixtures:

Bonding admixtures are water emulsions of several organic materials that are mixed with cement or mortar grout for applying on an old concrete surface just prior to patching with mortar or concrete.

2. **Concrete Curing Compounds**

   Liquid membrane curing compounds are used to reduce the loss of water from concrete during the early period of setting and hardening.

3. **Polymer Bonding Agents**

   The use of bonding agents improves the adhesion of new concrete or mortar to old surface. The mixing of bonding agents with concrete or mortar improves the workability even at lower water cement ratio and thereby reduces the shrinkage property.

4. Mould Releasing Agent

Wooden planks, ordinary plywood, shuttering plywood, steel plates etc. are used as shuttering materials. Concrete when set and hardened, adhere to the surface of the formwork and it becomes difficult to de-mould. To reduce the bond between formwork and concrete, special mould releasing agents are used.

Structural Elements of a Buildings:

1) Foundation:

Foundation is the lowest part of the building or the civil structure that is in direct contact with the soil which transfers loads from the structure to the soil safely

Functions of foundation:

- Foundation are the main reason behind the stability of any structure. The stronger is the foundation, more stable is the structure.
- The proper design and construction of foundations provide a proper surface for the development of the substructure in a proper level and over a firm bed.
- Specially designed foundation helps in avoiding the lateral movements of the supporting material.
- A proper foundation distributes load on to the surface of the bed uniformly. This uniform transfer helps in avoiding unequal settlement of the building.
- The foundation serves the purpose of completely distributing the load from the structure over a large base area and then to the soil underneath. This load transferred to the soil should be within the allowable bearing capacity of the soil.

2) Plinth:

Part of the structure between the ground and the raised floor of the house ie, it separates structure in to substructure and superstructure.

Functions of Plinth:

- It evenly distributes and disperses the load of the columns to the foundation evenly
- The plinth doesn't allow the dampness and moisture of the ground floor to reach the building's top structure
- In framed structure houses and buildings plinth beams are used as a barrier for protection from water seepage.
- Plinth protects the rest of the house from dampness.
- Provides a better aesthetic appeal to the building

- It also prevents cracks in the building when the foundation suffers from settlement

3) Lintel:

A lintel is the beam or other support at the top of a door or window.

Types of lintel:

1.Timber Lintels
2. Stone Lintel
3. Brick Lintels
4. Reinforced Brick Lintel
5. Steel Lintel
6. Reinforced Concrete Lintel

Functions of Lintel:

- Lintel supports the walls above the openings like doors, windows, etc.
- Lintel withstands the imposed loads coming from above bricks or block including the roofing members.
- The lintel is used to transfer all imposed loads to the side walls.
- Sometimes lintels are used as a decorative architectural element.

4. Chejja:

Chejja or Sun-Shade means a sloping or horizontal structural overhang, usually provided for protection from sun and rain or for architectural considerations at lintel level.

Functions of Chejja

- Usually protects from external sunlight.
- Also protects from rainwater entering into the building.
- It also serves as aesthetic decoration with little design on it from architectural point of view.

- Also it can be used as a support for AC.

5. Masonry wall

Masonry is a term used to indicate the part of the construction that uses brick, concrete blocks, structural clay tile, and stone. These materials are held together with mortar.

Types of Masonry walls:

i. Load-bearing masonry wall
ii. Reinforced masonry wall
iii. Hollow masonry wall
iv. Composite masonry wall
v. Post-tensioned masonry wall

i) Load bearing Masonry wall

A load-bearing wall is a wall that bears the load coming from the structure and transfers the load to the foundation

ii) Reinforced masonry wall:

A reinforced masonry wall is made with any type of brick, stone or concrete, reinforced by steel bars. This type of wall could be non-load-bearing or load-bearing.

iii) Hollow masonry wall:

Hollow masonry walls are made with hollow cement blocks. This type of masonry wall is used to stop dampness from getting inside the building. It creates a hollow area between the outside and inside of masonry walls

iv) Composite masonry wall

Composite Masonry walls are made with the combination of two or more building materials; stones and bricks or hollow bricks and bricks.

v) Post tensioned masonry walls

Post-tensioning provides an additional axial load to masonry structures and thus increases resistance to lateral force.

Functions of walls:

- The use of materials such as bricks and stones can increase the thermal resistance of a building.
- Masonry is a non-combustible product and can protect the building from fire.
- Masonry walls protect the structures from winds.
- Masonry walls protect the structures from direct sunlight.

6. Column

A column can be defined as a vertical structural member which transmits the loads from beam of the building to foundation.

Types of Columns:

1. **Square or rectangular column:**

Square column is generally used in the building construction and for heavy structures.

2. **Circular Column:**

Circular column is mostly used for aesthetic view in the elevation of buildings.

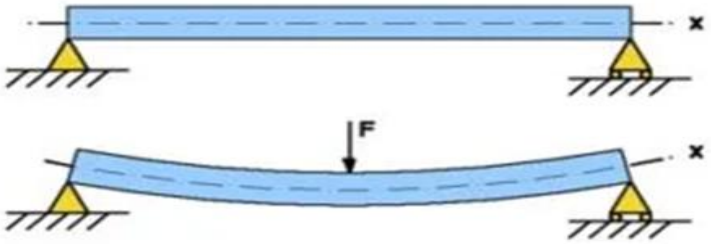
7. Beam:

A beam is a horizontal structural member in a building to resist the lateral loads applied to the beam's axis.

Types of beams:

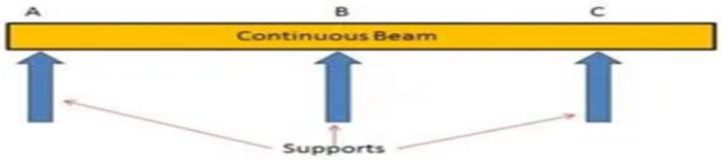
i) Simply supported beam:

A simply supported beam is supported at both ends. These beams are primarily used in general construction.



ii) Continuous Beam:

A beam that has more than two supports this kind of beam is called a continuous beam

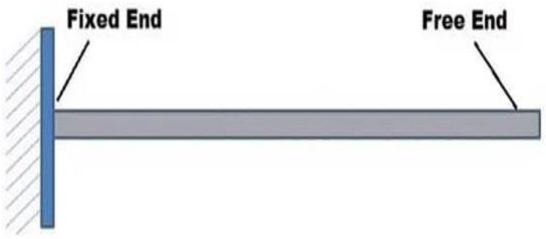


iii) Fixed Beams:

A beam that is fixed at both ends is called a fixed beam. Fixed beams are not allowed the vertical movement or rotation of the beam.

iv) Cantilever Beam:

A fixed beam is one where one end is fixed and other end is free.



8. Slab

A slab is a flat, two-dimensional structural component of building having a very small thickness compared to its length and breadth. It transfers the structural loads to the beams.

Types of slabs

- One way slab
- Grid slab system
- Flat slab system
- Two way slab

Functions/uses of slab

- provide a flat surface
- To act as sound, heat and fire insulator
- It provides a covering shelter or working flat surface in buildings
- Its primary function is to transfer the load to edge beams
- The upper slab becomes the ceiling for the lower storey.

9.Staircase:

A staircase is a set of steps leading from one floor of building to another floor. The staircase provide access from one floor to another floor

Types of Staircase

- **Straight Stair:** In these types of stairs, all the steps are arranged continuously along in one direction.

- **Dogged-legged Stair:** Dog Legged Staircase Dog legged staircase is the most economical staircase in which stairs are arranged with two adjacent flights running parallel with the mid-landing that is usually provided where there is less space or causing in economical use of available space.
- **Circular Stair:** A circular staircase resembles a circle in plan
- **Spiral Stair:** A spiral staircase is a round stair system in which the individual steps connect to a center column, hence forming a complete circle

Question Bank

1) Write the scope of following fields of civil Engineering
   i) Surveying
   ii) Structural engineering
   iii) Geotechnical engineering
   iv) Hydraulics and water resource engineering
2) Write the scope of following fields of civil Engineering
   i) Transportation Engineering
   ii) Environmental engineering
   iii) Construction planning and Project management
3) Explain brick. What are the uses of bricks and what are the qualities of good bricks.
4) Explain Cement. What are the Uses of cement?
5) What are the different types of cement and what are the good qualities of cement.
6) Explain mortar and what are the uses of mortar
7) Explain plain cement concrete. What are the uses of plain cement concrete
8) Explain Reinforced cement concrete. What are the uses of RCC
9) Explain Pre stressed concrete and uses of Pre stressed concrete
10) What is structural steel? Explain different types of steel
11) What are the uses of structural steel
12) Explain different types of chemicals used in construction.
13) Define foundation. What are the functions of foundation
14) Write definition and uses of following structural elements
   i) Plinth
   ii) Lintel
   iii) Chejja

iv) Masonry wall

15) Write definition types and functions of following structural elements

i) Column

ii) Beam

iii) Slab

iv) Stair case